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This document describes the procedures for determining the mechanical shock and vibration levels of wheeled vehicles, including on-board equipment, during operation over selected courses.

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TEST OPERATIONS PROCEDURE

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WHEELED VEHICLE SHOCK AND VIBRATION TESTS

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1. SCOPE.

a. This document describes the procedures for determining the mechanical shock and vibration levels of wheeled vehicles, including on-board equipment during operation over selected courses.

b. Shock and vibration levels of wheeled vehicles, components and crews can be high over rough terrains, causing considerable reduction in the life cycle of the equipment. It is important to determine these characteristics to obtain a basis for constructive improvement in design in order to reduce or alter the shock and vibration spectrum in the system. Testing may be done to define the environment such that carried systems or cargo can be improved to withstand the environment of the vehicle. Also, testing may be done to determine how to improve component design to withstand the current environment but not alter the environment.

c. The test procedures listed here can be used to generate input data for Method 514, Category 8, MIL-STD-810E**.

*This TOP supersedes TOP 2-2-808 dated 1 October 1981.

**Superscript letters correspond to those in Appendix A.

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2. FACILITIES AND INSTRUMENTATION.

2.1 Facilities (TOP 1-1-011[b] and ITOP 1-1-050[c]).

Item	Requirement
Test Courses Belgian Block Two-Inch Washboard Radial Washboard Three-Inch Spaced Bump Six-Inch Washboard Others as required by the test plan	To subject the vehicle to different road shock and vibration environments

2.2 Instrumentation.

Devices for Measuring	Measurement Accuracy
Acceleration	±5% of reading or ± 0.1 g, whichever is greater
Vehicle speed	±0.4 km/hr
Displacement (if required)	±2% of reading
Strain (if required)	±5% of reading or ±100 microstrain, whichever is greater

3. REQUIRED TEST CONDITIONS.

3.1 Test Vehicle. Ensure the following:

a. The vehicle is loaded with normal payload or combat weight, unless otherwise specified.

b. Maintenance and service operations have been performed to ensure that the vehicle is operating within specifications. Give particular attention to the engine, transmission, suspension system and electrical system.

c. The tire pressures are adjusted to the off-road pressures unless specified in the test plan.

3.2 Test Courses. All concrete courses shall be clean.

4. TEST PROCEDURE.

a. Obtain measurements at sufficient road speed increments to adequately

define vibration levels. The road speed increments should be 8 km/hr or less to obtain sufficient data. The vehicle speeds should range from 8 km/hr to the maximum safe operating speed on each course.

b. Use accelerometers, displacement transducers and strain gages with an appropriate pass band.

c. Record vibration data for a sufficient time at each road speed to allow for a minimum of 25 spectral averages.

d. For each measurement channel, obtain data sampling at a rate at least equal to four times the maximum frequency of the pass band.

e. Record data using telemetry, on-board tape recorders, or similar devices.

f. Verify that the data are accurate and reasonable (data should be checked for inconsistencies such as wild points and also for stationarity).

5. DATA REQUIRED.

a. Test course.

b. Vehicle speed.

c. Required measurements by vehicle speed.

(1) Triaxial acceleration on each of the crew seat's surface (accelerometers to be installed on a semigrid disc) to measure whole body vibration (new vehicles and/or vehicles with modified suspension systems) (see ISO Standard 2631-1985[d]).

(2) Triaxial acceleration on axles (new vehicles and/or vehicles with modified suspension systems) (see ITOP 1-1-050).

(3) Triaxial acceleration on cargo bed (new vehicles and/or vehicles with modified suspension systems).

d. Displacement data (if required).

e. Strain data (if required).

f. Possible additional measurement locations:

(1) Vehicle components.

(2) Electrical components.

(3) Equipment racks.

6. PRESENTATION OF DATA.

a. For relevant mechanical vibration measurements, present the data from each axis as follows:

(1) Power spectral density (PSD) function.

(2) Amplitude distribution.

(3) Other analysis techniques required by the individual vehicle.

b. For relevant mechanical shock measurements, present the data for each axis as follows:

(1) Acceleration time histories.

(2) Shock response spectra (SRS).

c. For displacement and strain measurements, present the data as follows:

(1) Amplitude distribution.

(2) Displacement/strain time histories.

d. Provide description of the data acquisition system.

e. Define data analysis method used (e.g., sampling rate of each channel, analysis bandwidth, time duration of data analyzed, filter characteristics, windowing, number and type of spectral averages).

Recommended changes of this publication should be forwarded to Commander, U.S. Army Test and Evaluation Command, ATTN: AMSTE-CT-T, Aberdeen Proving Ground, MD 21005-5055. Technical information may be obtained from the preparing activity: Commander, U.S. Army Combat Systems Test Activity, ATTN: STECS-PO-I, Aberdeen Proving Ground, MD 21005-5059. Additional copies are available from the Defense Technical Information Center, Cameron Station, Alexandria, VA 22304-6145. This document is identified by the accession number (AD No.) printed on the first page.

APPENDIX A REFERENCES

REFERENCES FOR INFORMATION ONLY

a. MIL-STD-810E, Environmental Test Methods and Engineering Guidelines, 14 July 1989.

b. US TOP 1-1-011, Vehicle Test Facilities at APG, 6 July 1981.

c. FR/GE/UK/US ITOP 1-1-050, Development of Laboratory Vibration Test Schedules, 14 May 1993.

d. ISO Standard 2631-1985, Guide for the Evaluation of Human Exposure to Whole-Body Vibration, 1985.